Approaches to Spatial Disorientation

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Knowledge and models of the systems that control whole-body motion relative to the earth are insufficient to predict and understand the perceptual and sensorimotor reactions that occur during complex conditions of motion¾particularly when changes in gravito-inertial force levels are encountered. We propose that efforts to deal with complex conditions of motion are necessary to understanding these effects in operational aviation and will promote substantial advances in knowledge of mechanisms of goal-directed control of whole-body motion and spatial orientation. The objectives of the work are to provide accurate reliable information on the perceptual and sensorimotor reactions that occur during and after complex, controlled motion, and to advance existing models and theory on the basis of advances in psychophysical and neurophysiological information.

Anticipated products include:

a. Improved mathematical models of sensorimotor and control systems involved in the control of whole body motion relative to the earth.

b. Improved anticipation of exceptional disorientation in new-generation aircraft and an improved ability to understand disorientation effects in current aircraft.

c. Functional specifications for flight instruments to aid in spatial orientation.

d. Computer-based models to optimize the utilization of current spatial disorientation trainers.

e. Functional specifications for dynamic flight simulators and computer-based models to assure the rational utilization of dynamic flight simulators and expensive multi-axis SD trainers currently being procured by DOD.

f. Computer-based models for use by accident investigators in which dynamic flight information for a 5-minute period preceding the accident can be used to predict probable dynamic and static components of the spatial orientation perception of pilots.

g. Development of an information base from which new biomedical tests of vestibular function can be derived.

The first series of studies utilized linear motion tracks to develop information on the perception of pitch. A unique linear track on a rotating platform (see figure) was used to obtain data involving high linear accelerations in the low-frequency range. The second series will compare the angular extent of perceived turns when the head is on center and when the head is positioned at various radial distances from center. The third series involves the centrifuge and will study in detail how semicircular canal and otolith information interact to influence the dynamics of spatial orientation during hypergravity.